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THE PEACH BORER

HOW TO PREVENT OR LESSEN ITS RAVAGES

Rev. ed. follows

FOR MORE than a century and a half the peach borer, the larva of a beautiful clear-winged moth, has been one of the principal obstacles to successful culture of the peach. It feeds on the soft inner bark at the base of the tree or on the adjacent roots, seriously injurying and frequently killing the tree. This bulletin treats briefly of the insects's life history and habits and discusses the following three methods of control: (1) The application of paradichlorobenzene, which has been successfully used for more than 20 years on older trees, although often causing damage to trees 3 years of age or younger; (2) the more recently developed ethylene dichloride treatment, which is more effective than the use of paradichlorobenzene in cool weather and much less likely to cause injury to younger trees; and (3) the old-time practice of "worming," a method suitable for the destruction of borers if only a few trees are to be treated or if it is inconvenient to obtain a supply of suitable chemicals.

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THE PEACH BORER—HOW TO PREVENT OR LESSEN ITS RAVAGES

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CONTENTS

AMONG INSECT PESTS that attack the peach few, if any, are potentially more injurious than the peach borer (*Sanninoidea exitiosa* (Say)).[2] Throughout much of its range of distribution, east of the Rocky Mountains from Canada to Florida, and in certain restricted areas farther west, it causes serious injury and the premature death of many trees wherever treatment is neglected.

The peach borer is a native of the United States and has been reported in horticultural and other literature almost from the time the early settlers introduced the peach into this country. Its original food plants were doubtless the wild cherries and wild plums, and on these it can still be found. It also attacks other stone fruits, such as nectarine, apricot, prune, almond, plum, and a few other closely related fruit trees. It is, however, preeminently injurious to the peach.

CHARACTER OF INJURY

The injury is done by the larva, or borer, which feeds in the trunk principally at or somewhat below the ground level and eats galleries or burrows in the soft bark or cambium at the crown of the trees or along the larger roots (fig. 1). Young trees may soon be completely girdled (see title page), or nearly so, and older trees so injured that their vitality and crop-bearing capacity are greatly reduced. Injured trees are particularly susceptible to attack by bark beetles and are less able to withstand periods of drought.

Infestation by the borer is usually shown by an exudation of jelly-like gum around the crown, more or less mixed with dirt and brown

[1] When first published, in October 1921, this bulletin was under the authorship of A. L. Quaintance, Associate Chief of the then Bureau of Entomology (resigned December 31, 1930); later, in July 1932, it was revised, still under Dr. Quaintance's authorship, by B. A. Porter and Oliver I. Snapp.

[2] Order Lepidoptera, family Aegeriidae.

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pellets—the excrement, or frass, voided by the borers (fig. 2). This exudation of gum is especially evident during damp or rainy weather.

HOW THE INSECT DEVELOPS AND LIVES

In the course of its life the peach borer goes through four distinct stages—the egg; the larva, or borer; the pupa; and the adult, or parent moth. There is only one generation a year. The eggs hatch in the summer and fall, and the young borers at once attack the trees, passing the winter as partly grown larvae in their burrows. In the spring they resume their growth and mature and spin their cocoons at various times during the summer. The moths emerge during the summer and fall, the exact period differing in different localities. Shortly after emerging the moths lay their eggs.

FIGURE 1.—Peach borers in their galleries at the crown of a peach tree.

THE EGG

The eggs of the peach borer are small and inconspicuous, reddish brown, oblong, and measure about one-fiftieth of an inch in length (fig. 3). Most of the eggs are deposited on the trunk of the tree near the base, although some are placed on the limbs and foliage of the peach tree and a few are laid on weeds and trash or on the ground at or near the bases of the trees. Naturally many larvae fail to establish themselves on the trunks of the trees, but this loss is more than offset by the fact that the moths are very prolific. Observations have shown that a single female may lay more than 1,200 eggs, and the average is probably between 500 and 600.

THE LARVA, OR BORER

The egg hatches in about 10 days, and the little larva coming out of it makes its way as rapidly as possible to the collar of the tree, if

not already in that area, and at once begins burrowing into the bark, often entering through a crack or wound. After the larva has gained entrance to the soft bark of the tree it feeds greedily and grows rapidly, and in a few weeks is sufficiently large to do material damage.

The number of larvae which may infest a single tree is often surprising, and it is a matter of wonder that trees heavily infested are not completely killed within a season. The average number of larvae to a tree in orchards differs widely according to the region. In some regions there are only 2 or 3, whereas in others 8 or 10 borers are usually present. In extreme cases 40, 60, and even 90 borers have been found infesting the roots and crowns of individual peach trees 6 or 7 years old.

The hatching period extends over most of the summer and fall—from late June until October, or even later in the extreme South, although most of the hatching is concentrated in a period of a few weeks in midsummer in northern localities and in late summer or fall at southern points. Larvae of different sizes, however, ranging from small to nearly full-grown may be found in the trees at any time during the summer and fall.

Most of the feeding occurs in the fall and spring, but in the South the borers also feed more or less during warm periods in the winter. The mature peach borer larva (fig. 4) is about an inch long and yellowish white and has a dark reddish head.

FIGURE 2.—Gum and frass exuding from base of a peach tree, the usual sign of infestation.

THE PUPA

The peach borer, when full-grown and ready to change its form, incloses itself in a cocoon of silk in which are incorporated particles

of bark and excrement, forming a tough, brownish, capsulelike structure. The cocoon (fig. 5) is usually constructed at the entrance to the larval burrow or even a short distance outside it and, because it is similar in color to the bark of the tree, is often overlooked by orchardists. Borers infesting the roots some inches from the base of the tree may work directly upward to the surface of the soil and there construct their cocoons. Sheltered within the cocoon, the larva changes to a pupa, or chrysalis. The pupa (fig. 6) is about three-fourths of an inch long and is brown. On its back are stiff spines that assist it in working itself out of the cocoon and thus facilitate the escape of the moth. Within 3 or 4 weeks the pupa is fully developed and wriggles out. The emerging moth leaves the empty skin protruding more than halfway from the cocoon (fig. 5). Late in the summer large numbers of these empty pupal shells may often be found around the base of a heavily infested tree.

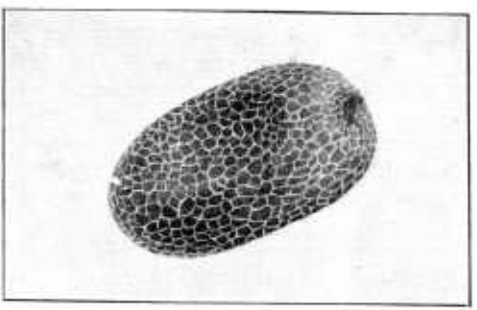

FIGURE 3.—Egg of the peach-borer moth. Sixty times natural size.

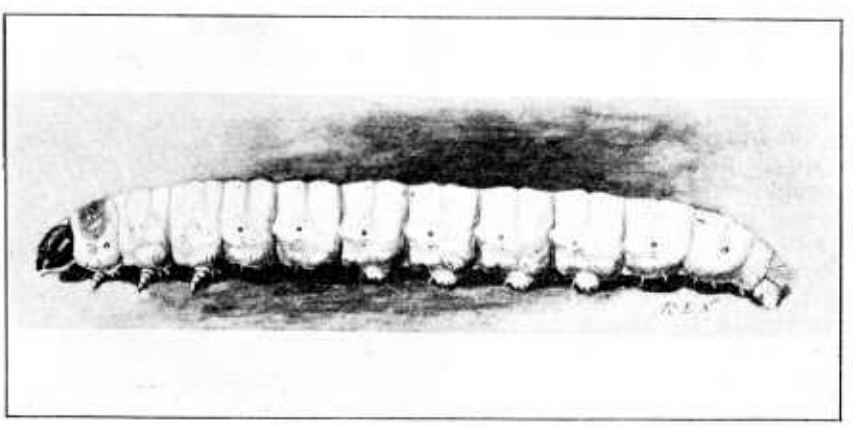

FIGURE 4.—The peach borer. Four times natural size.

THE MOTH

The moths of the peach borer are beautiful, clear-winged insects, the male differing strikingly from the female in markings. The wings of the male (fig. 7) are transparent, with steel-blue trimmings along the margin and veins, and its abdomen is marked with narrow yellow bands conspicuous on the steel-blue ground color. The female (fig. 8) is steel blue, with opaque forewings, and has one or two orange-colored bands around the abdomen.

The adults are day fliers and when on the wing are sometimes mistaken for wasps. Egg laying begins very soon after emergence. It

is doubtful whether the moths feed to any extent, and within a few days the eggs have been deposited, and the moths have died.

HOW TO CONTROL THE PEST

Two very effective insecticides are now available for peach borer control. The first of these, paradichlorobenzene, has been in use for more than 20 years. It is very effective in controlling the borers, but in some localities it is injurious to the younger trees. The second chemical, ethylene dichloride, has been under experiment at the Fort Valley, Ga., laboratory of the Bureau for the last 8 years. It has also been tested extensively in Illinois and New York in cooperation with State workers and has been used by a considerable number of commercial growers in the eastern half of the United States. This treatment has the advantage of being comparatively safe on young trees when applied at the proper strength; it can be used in colder weather than paradichlorobenzene; and it can be applied with greater ease.

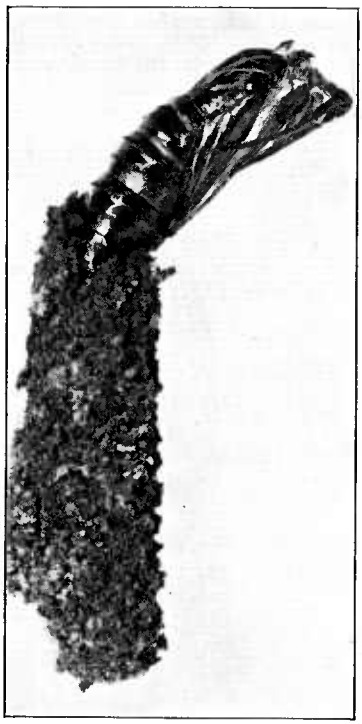

FIGURE 5.—The peach borer cocoon and empty pupal skin. Three times natural size.

THE PARADICHLOROBENZENE TREATMENT

Paradichlorobenzene, often referred to as "para" or "PDB", is a white crystalline substance having an etherlike odor and vaporizing readily under favorable conditions. The vapor, while harmless to persons and domestic animals under ordinary conditions, is poisonous to insects confined in its fumes for a sufficient length of time. It is heavier than air and readily permeates the soil. The chemical is, for practical purposes, noninflammable. In purchasing paradichlorobenzene orchardists should demand a grade having the fineness of granulated sugar or one coming in small, thin, flaky crystals. Only the pure chemical should be purchased. Then, if there is some loss by evaporation in the containers, the portion of the chemical that remains is always 100 percent pure. If the chemical is mixed with some inert material the loss by evaporation will be loss of the chemical only, and the strength of the remaining mixture will be unknown.

WHEN TO APPLY IT

Application of paradichlorobenzene to peach trees for the control of the peach borer is most effective in the fall, after most of the moths have laid their eggs. At this time many of the larvae are still small and more or less exposed, and hence are more susceptible to the

gas than if they were deep in their burrows in the crown and roots. Applications must not be delayed, however, until the soil temperature is so low that the chemical will not volatilize properly. Exact information on the best time for treatment in various localities should be obtained from the reader's State agricultural experiment station, extension service, or local authorities. The best approximate dates for certain regions are, however, as follows:

Michigan, New York, and New England States	Aug. 25–Sept. 10.
Southern Lake region, New Jersey, Pennsylvania	Sept. 15–25.
Ozark region, Ohio Valley, Maryland, Virginia, Delaware	Sept. 25–Oct. 5.
Northern Georgia, the Carolinas, Tennessee	Oct. 5–15.
Central Georgia	Oct. 20–25.
Southern Georgia	Oct. 25–30.

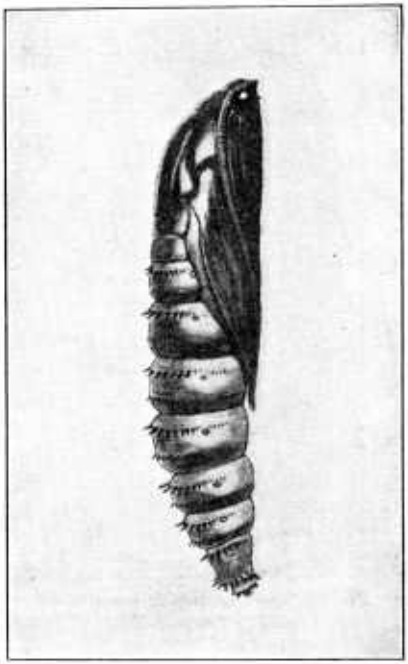

FIGURE 6.—Pupa of the peach borer. Four times natural size.

Fall applications are most effective, but if these have been neglected or were poorly timed, treatment sometimes becomes desirable in the spring. Spring applications of the chemical have given a fairly satisfactory kill, although by that time the borers have of course caused much more damage than would have occurred if they had been killed early in the fall while still small. Spring treatment should be given as soon as the ground begins to warm, the exact time differing with the locality.

PREPARING THE TREES

The earth for 15 or 18 inches around the base of trees should be cleaned of grass and weeds and leveled off, without, however, digging up the soil any more than necessary to break the surface crust (fig. 9, *A*). If borers are in the trunk somewhat above the ground level, as indicated by the presence of gum or frass, a few shovelfuls of earth should be thrown around the tree and leveled off to form a bed on which the chemical will rest above the infested part of the trunk, for this heavy gas sinks rather than rises through the soil. As a rule, raising the soil level around the tree is unnecessary and is undesirable because the mound may be washed down by rain and the effectiveness of the treatment reduced. Excessive gum and frass should be removed. Exposed roots should be covered with a light layer of soil, since they are less resistant to gas fumes than is the bark of the trees.

APPLYING THE CHEMICAL

After the soil has been prepared, the chemical is applied evenly in a band an inch or so wide entirely around the tree, care being taken that the inner part of the band is an inch to an inch and a half from the trunk (fig. 9, *B*). The crystals should not be placed in contact with the tree, since they may injure it, nor should they be placed too far from the tree, in which case not enough gas will reach the tree trunk to be effective. For mature trees of average size 1 ounce, by weight, should be used; for unusually large trees an ounce and a half or more is sometimes needed; for trees 4 to 5 years old, three-

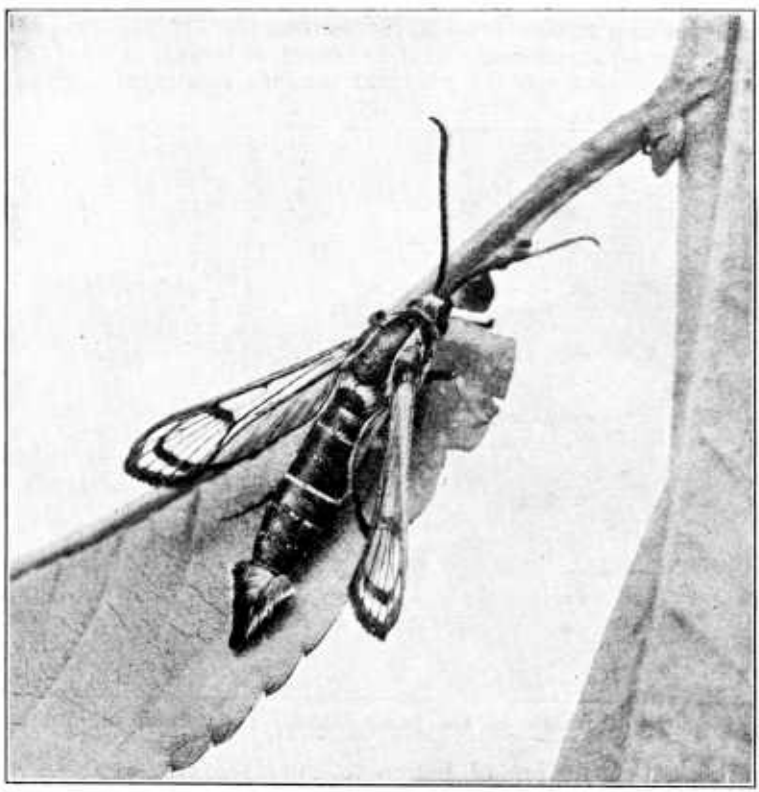

FIGURE 7.—Adult male of the peach borer resting on leaf. Four times natural size.

fourths of an ounce; and if trees 1 to 3 years of age are to be treated, one-fourth to one-half ounce should be used. If many trees are involved, a container holding exactly the required amount of paradichlorobenzene is a great convenience. A small metal cup holding an ounce is often furnished with the chemical by insecticide dealers. As soon as the paradichlorobenzene has been applied, it should be covered with several shovelfuls of dirt, care being taken not to disturb

the ring of crystals, and the dirt packed with the back of the shovel (fig. 9, *C*) to make a low cone-shaped mound.

Under normal temperatures the chemical applied at the recommended dates usually evaporates in 4 to 6 weeks. If unusually low temperatures prevail or if frequent rains keep the soil wet, the evaporation of the chemical may be considerably retarded. Under such conditions, especially on trees less than 6 years of age, it is sometimes desirable to tear down the mounds after from 4 to 6 weeks to prevent the injury which might result from a prolonged exposure to the fumes of the chemical.

If the mounds are torn down late in the fall, just before winter sets in, fresh earth should be placed around the tree to prevent winter injury in event of a sudden drop in temperature.

Late in the spring or early in the summer it is well to level off the mounds remaining from the previous season's treatment. This permits the new generation of borers to enter the tree at the normal location on the trunk, and facilitates the subsequent application of paradichlorobenzene.

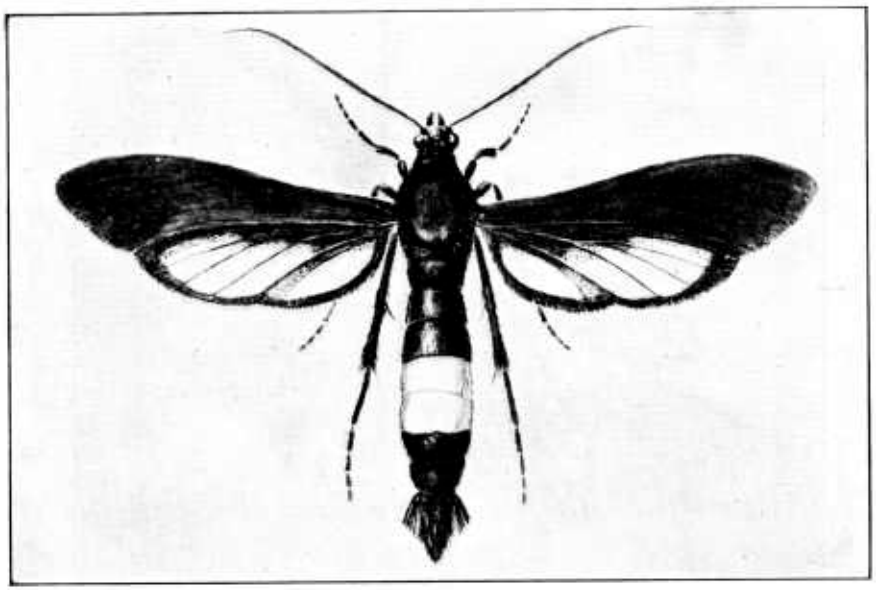

FIGURE 8.—Adult female of the peach borer. Four times natural size.

INJURY

Under certain conditions paradichlorobenzene may cause injury to peach trees. This injury first becomes evident as brown flecks in the bark layers, which may continue into the cambium. In cases of severe injury these flecks converge into spots, forming a continuous layer of sour, brown tissue, which finally dies. Sometimes the injury extends all the way around the trunk and becomes fatal to the tree.

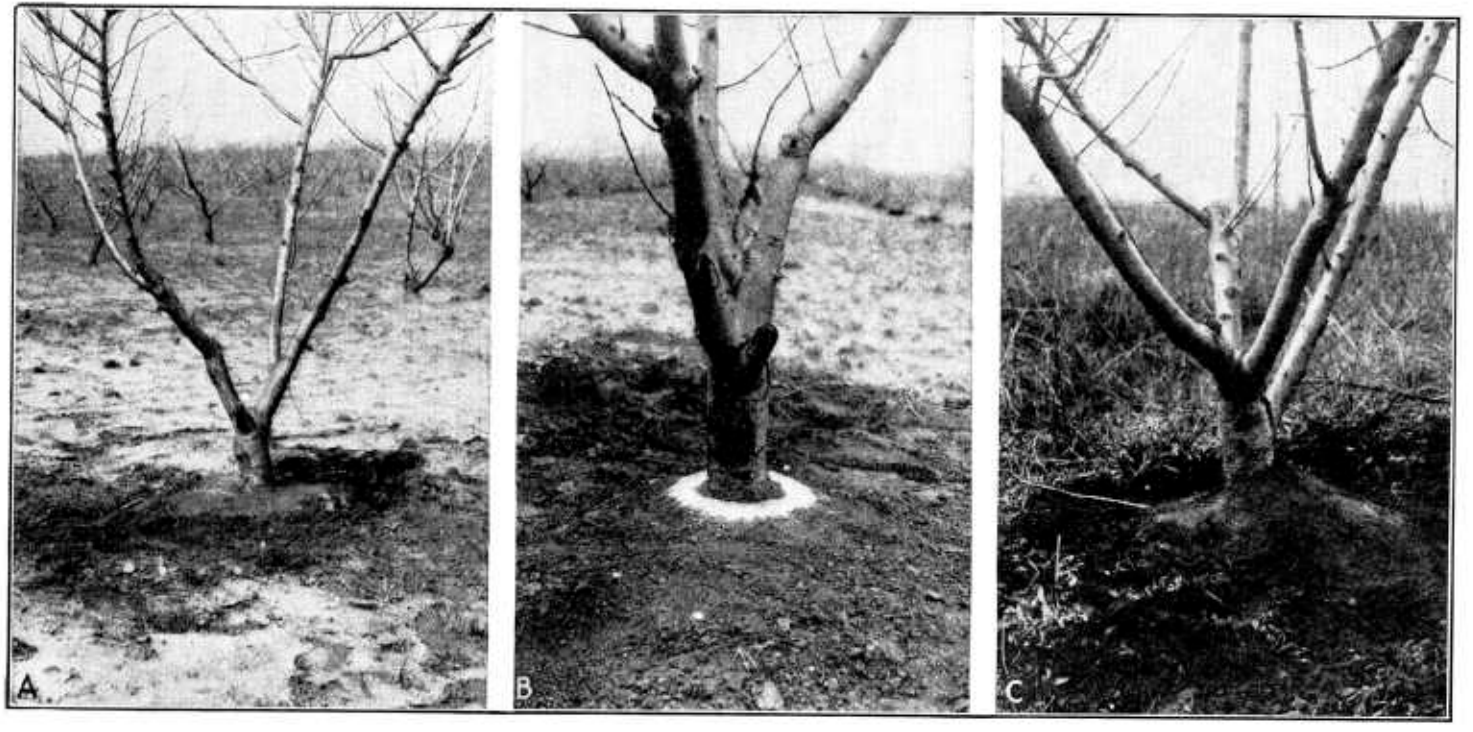

FIGURE 9.—Steps in the correct method of treating trees with paradichlorobenzene: *A*, The soil around this peach tree has been made ready for treatment; *B*, the ring of crystals should be from 1 to 1½ inches from the tree trunk; *C*, several shovelfuls of soil should be placed on top of the ring of crystals and packed lightly with the back of a shovel.

Injury has been particularly serious on trees 1 to 3 years old in the southeastern part of the country. In a few cases this injury has been severe enough to kill the trees. In many peach sections of the Middle West injury to young trees has occurred less frequently, and in that part of the country many commercial growers make a practice of treating young trees. Trees 4 years of age and older have sometimes suffered slight injury, but this has rarely proved serious. The paradichlorobenzene treatment has been found injurious to peach trees in the nursery and is therefore not recommended for nursery stock.

THE ETHYLENE DICHLORIDE TREATMENT

Ethylene dichloride is a colorless liquid with an odor like chloroform. It is heavier than water and vaporizes freely at ordinary temperatures. The vapor is heavier than air and penetrates the soil very readily. The chemical is only very slightly soluble in water, and it burns with difficulty when ignited by a lighted match. When the vapor of ethylene dichloride is inhaled it has an anaesthetic action, although less rapid than that of chloroform. Unless breathed in high concentrations over a protracted period of time no harmful results need be feared in working with this compound. Long-continued contact with ethylene dichloride has been reported to have caused some skin irritation, and due care should be taken by people who have occasion to work with this material for long periods of time.

PREPARING ETHYLENE DICHLORIDE EMULSION

To avoid concentration of the vapor and any prolonged breathing of it, the emulsion should be prepared out of doors or in a well-ventilated room. It is desirable that the air temperature be between 50° and 80° F. Since the compound boils at temperatures below the boiling point of water, heat should not be employed in making the emulsion, and the liquid should be kept away from fire and open-flame lights.

The stock emulsion is prepared from the following ingredients:

	Parts
Potash fish-oil soap	1
Water	8
Ethylene dichloride	9

A good grade of potash fish-oil soap should be used, that is, one without an excess of caustic potash and containing approximately 30 percent of actual soap and 70 percent of water. The soap should first be put into the mixing vessel and the water added slowly while stirring, until the soap is well dissolved. The ethylene dichloride should then be added and emulsified cold by pumping the mixture into another container.

The stock emulsion may also be made by stirring. By this method the soap is first placed in the mixing container and the ethylene dichloride added slowly, a little at a time, with constant stirring. When the soap and ethylene dichloride are thoroughly mixed, the water is added slowly with constant stirring.

The stock emulsion made by either method contains 50 percent of ethylene dichloride; it is further diluted with water just before it is used, the amount of dilution depending on the age of the tree and the dosage required.

If the stock emulsion breaks down after preparation, as indicated by the presence of a curdled mass or a layer of clear ethylene dichloride on the bottom, and cannot be readily remixed by moderate agitation, the material must be re-emulsified. This is done by pumping the mixture from one container to another or back into the same container, or by starting over again with a small quantity of potash fish-oil soap to which small quantities of the broken emulsion are added slowly at intervals with constant stirring.

Commercially prepared emulsions are available on the market and bear directions for dilution and use on the packages.

DILUTION AND DOSAGE

Table 1 gives the quantity of water to be added to the 50-percent stock emulsion of ethylene dichloride to get 10 gallons of diluted emulsion of the different strengths and the dosages found by experiment to be most satisfactory for use on peach trees of various ages.

TABLE 1.—*Dilution of stock emulsion, strength of diluted emulsion, and quantity applied to trees of different ages*

Age of trees (years)	Quantity of water and of stock emulsion to use to get 10 gallons of diluted emulsion of the proper strength		Strength of the diluted emulsion	Quantity of the diluted emulsion for each tree
	Water	50-percent emulsion		
	Gallons	*Gallons*	*Percent*	*Pints*
4 and older	6	4	20	½
3	7	3	15	½
2	7	3	15	¼
1	8½	1½	7.5	⅛

Unusually large older trees may require a little more than a half pint of the emulsion.

WHEN AND HOW TO APPLY THE EMULSION

Ethylene dichloride emulsion can be applied for the control of the peach borer any time during the fall or spring, and in the South applications made in warm periods during the winter will give good control. Best results will probably be obtained in the fall soon after the close of the egg-laying period of the peach borer moths, when most of the borers are small. The use of the material in extremely hot weather should be avoided since injury is more likely to occur at high temperatures.

No preparation of the soil before treatment is necessary on loose, level ground. In some cases, however, cupping the soil slightly toward the tree trunk, to prevent the liquid from running off, or loosening the soil around the tree sufficiently to permit the liquid to be readily absorbed will give better results. Any cracks in the ground around or extending out from the tree trunk should be filled with soil before the treatment is applied in order that undue concentration of the material on any part of the root system, which might result in injury, may be avoided.

FIGURE 10.—Pouring ethylene dichloride emulsion from a short-handled household measuring cup.

The material is applied either by pouring or spraying it on the soil around the base of the tree in such a way that the soil will absorb and hold it around the tree at the ground line. It should not be poured or sprayed on the trunk.

A tin household measuring cup holding one-half pint, with marks for one-eighth and one-fourth pint, will be found useful in applying the emulsion (fig. 10). A bucket pump may be employed in applying the ethylene dichloride, and with a little practice the quantity delivered to each tree can be regulated without difficulty. A power sprayer equipped with a device for regulating the quantity applied may also be used for this purpose.

It is essential that a uniform mixture be obtained, both in the stock material and the fully diluted spray. The stock emulsion should be thoroughly stirred before any is taken from the container for dilution,

and the diluted emulsion should be agitated before each dose is withdrawn for use around the tree. Each bucket of diluted material should be provided with a paddle for agitation if the applications are to be poured on. The operator should examine the emulsions at frequent intervals to be certain that they have not broken down, permitting the ethylene dichloride to form a separate layer at the bottom of the container. Broken-down emulsions should not be applied, as the portion consisting chiefly of ethylene dichloride may cause serious injury.

After the chemical has been applied, several shovelfuls of soil should be placed against the tree to prevent evaporation from the surface. After this the treatment needs no further attention.

WORMING

Before the development of chemical methods for combating the peach borer, growers relied for control chiefly on digging the borers out by hand. This method is still very useful for the control of the borer in small plantings or on single backyard trees or where it is inconvenient to obtain a supply of the chemical. Worming, however, is a very laborious task and, unless carefully done, is not very effective.

In preparation for worming, the earth should be removed from around the crown of the tree to a depth of 4 or 5 inches, or deeper if necessary. With a little experience the worker can readily locate the borers in their burrows and remove them with a knife or other suitable tool. In worming, care should be taken not to cut the sound bark more than necessary, and the cutting should be done vertically. Carelessness in the use of worming tools may result in as much damage to trees as would be caused by the insects. After the trees have been wormed, it is desirable, if practicable, to go over them again a few days later, when the location of any larvae missed during the first examination will usually be indicated by the exuded frass or gum. When the worming has been completed, the earth should be replaced around the trees before freezing weather sets in.

If worming is to be done, it is helpful to mound the trees somewhat during the early part of the summer. This causes the newly hatched borers to attack the tree a little higher than would otherwise be the case, and the task of removing them by hand is somewhat simplified.

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